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| **The Cryptographer’s Curse** | | |
| **Introduction** | The ‘escape room’ model sees players willingly locked in a room and, by searching for clues and completing a series of challenges, they race against the clock to ‘break out’. This lesson is an adaptation of the popular ‘escape room’ model, which sees learners solve puzzles in order to open physical and/or digital locks. | |
| **Overview** | In this lesson, learners will explore the fascinating world of ciphers, improving their analytical skills as they work to decipher different codes. Through engaging, hands-on activities, they will discover how ciphers protect information and ensure privacy in communications. By the end of the lesson, learners will not only be skilled at cracking codes but will also understand the important role of encryption in securing data. | |
| **Learning Objective/s** | * Understand the concept and purpose of ciphers. * Learn to use and decrypt ciphers such as Caesar Shift, Polybius Square, and Pigpen ciphers. * Apply critical thinking to solve encoded messages. | |
| **Keywords** | * Cryptanalysis, cryptography, cipher, plaintext, ciphertext, encryption, enciphering, encoding, decryption, deciphering, decoding, computational thinking, decomposition, abstraction, algorithmic thinking. |  |
| **You will need** | * The Cryptographer’s Curse PowerPoint slides * Password protected document: Password = TURING * Timer (e.g., https://www.online-stopwatch.com/eggtimer-countdown/) * Cryptographer’s challenge: worksheet * Cryptographer’s challenge: help sheet * Cryptographer’s solution: teacher’s guide | |
| **National curriculum links** | **National Curriculum England:**  ***KS3***   * Understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits. * Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems.   ***KS4***   * Develop and apply their analytic, problem-solving, design, and computational thinking skills.   **Curriculum for Wales**  ***Area of Learning and Experience:***  *Progression Step 4*   * I can decompose given problems and select appropriate constructs to express solutions in a variety of environments.   *Progression Step 5*   * I can identify, define and decompose problems, choose appropriate constructs and express solutions in a variety of environments. | |
| **Computational thinking skills** | Code breaking is an excellent way to demonstrate computational thinking. Here are some ways that this lesson helps learners develop key computational thinking skills that are necessary for studying computer science:   * **Decomposition:** Breaking down complex problems into smaller, more manageable parts. Code breaking requires learners to deconstruct ciphers into individual components and steps. For example, with the Caesar shift cipher, students must isolate each letter and apply the shift rule. * **Pattern Recognition:** Looking for similarities among and within problems. Identifying recurring patterns is crucial in code breaking. In the Pigpen cipher, learners must recognise symbol patterns corresponding to letters, while in the Polybius square, they must identify number-letter pairs. * **Abstraction:** Focusing on the important information only and ignoring irrelevant detail. In code breaking, this might mean looking at the structure of a cipher without getting bogged down by the content of the message itself. | |

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| **Activity (inc timing)** | **Description** | **Tips** |
| **1 Starter activity**  (Slides 2–3)  5 mins | **Cracking the code**   * Place the learners into pairs (or small groups) and display the example Caesar shift cypher (Slide 2) on the board/screen. Challenge the learners to decipher the hidden message. * After 5 minutes, or when the first group of learners crack the code, reveal the answer and explain how a Caesar shift cypher works (Slide 3). | * ***Answer:*** The clue is in the name * ***Hint:*** The hidden message refers to the professor’s surname, Pentagram (A five-pointed star). Five is the number of shifts required to solve the Caesar shift cipher and the number of rows/columns required to solve the transposition cipher. As an additional clue, learners will also find images of pentagrams on their worksheet and help sheet. |
| **2 Introduction**  (Slides 4–10)  10 mins | **A brief history of code breaking**   * Set the scene by sharing Alan Turing’s contribution to computer science and the world of code-breaking (Slides 4–6). * Share some examples of common ciphers and explain how they work (Slides 7–10). | * If you’re stretched for time, you can skip the starter / introduction and jump straight into the main challenge. To speed things up, you can give the learners the solution to the starter activity and part of the solution. For example, you may wish to tell learners that we already have part of the code, the solution to the transposition cipher (level 3), but they must find the remaining missing numbers. |
| **3 Main Activity**  (Slide 11)  30 mins | **The Cryptographer’s Challenge**   * Place the learners into groups of four or five and hand out copies of the worksheet. Read out the scenario (slide 11) and set a timer to 30 mins (**Note:** you may adjust the timer depending on the length of the activity). * Place a laptop/tablet with the password protected PowerPoint at the front of the room. Start the timer and inform the learners that they have the time remaining to find the code to the PowerPoint and break the cryptographer’s curse. | * Don’t worry if learners fail to solve all the puzzles in time. It’s not about beating the game; it’s about developing problem solving and critical thinking skills. * If you see that the students are really struggling with the Caesar shift and Polybius square ciphers, you can give them clues by asking questions such as ‘What is the significance of the pentagram symbol?’ or ‘How many sides does a pentagram have?’ etc. You can also encourage the teams to split into pairs and each tackle a different cipher. * Switch off any screen savers and or screen locks on the device containing the password protected PowerPoint. |
| **4 Plenary**  (Slides 12–13)  5 mins | **Time for reflection**   * In the final part of the lesson, ask a member from each team to describe one of the ciphers they encountered and explain how they were able to solve it. * Ask the learners why they think we need to encrypt information. * Conclude the lesson by sharing the importance of encryption (Slide 13). | * Try to draw out answers such as: ‘To secure sensitive data such as credit card details when submitting them through websites’ or ‘To protect personal data when storing / transmitting via the web’ etc. |
| **5 Extension activity**  (Slide 14) | **Secret message challenge**   * If the learners complete the main task within the allotted time, challenge them to create their own encoded secret message using any one of the ciphers used during the session. | * Alternatively, you can set this task as homework. |
| **Take it further:**  **Physical locks**   * Traditionally, break-out games require learners to solve clues in order to open physical locks. This activity has been designed so that it can be played using 4-digit padlocks. What you will need:   + 1 x Lockout hasp (Used for attaching multiple padlocks to the same locking mechanism)   + 3 x 4-digit padlocks (one for each cipher)   + A lockable box * Instructions:   + Start the lesson by placing a printout of the ‘We broke out’ slide (Slide 16) inside the box.   + Close the box and attach the lockout hasp.   + Attach the three 4-digit padlocks and mix up the combinations:     - Padlock 1 = 2233     - Padlock 2 = 4224     - Padlock 3 = 5444   + Start the timer.   **Digital escape room**   * If you don’t want to go down the route of purchasing numerous locks, there are a number of ‘digital’ alternatives, such as using password-protected files or password protected sections in OneNote. | | |
| **Bonus idea:**  The escape room model offers a fun and interactive experience that fosters resilience and critical thinking skills. These immersive challenges can also serve as effective tools for reinforcing learning. Consider designing your own escape room—perhaps centred around binary representation or binary addition. | | |
| **Assessment opportunities:**   * Starter: You can ask the class how were able to solve the Caesar Shift cipher. * Main activity: You can ask the learners how they were able to solve each of the different ciphers. * Plenary: Ask the learners why they think we need to encrypt information. | | |